Application for Part 70 Combined Source Modification and Permit Modification DDG Dryer Construction

MGPI of Indiana, LLC
Operating Permit: 029-32119-00005
Lawrenceburg, Indiana

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1 Introduction

MGPI of Indiana, LLC (MGPI) owns and operates a stationary distilled spirits production facility located in Lawrenceburg, Indiana (see Figure 1). The facility is currently authorized to operate as a Title V major source) under Part 70 Operating Permit 029-32119-00005, which the Indiana Department of Environmental Management (IDEM) issued on June 20, 2014. Emissions of the following pollutants are permitted above Title V major source levels: particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), volatile organic compounds (VOC), nitrogen oxides (NO_x), and hazardous air pollutants (HAPs The MGPI facility is located in Dearborn County Lawrenceburg Township, which is designated marginal nonattainment for the National Ambient Air Quality Standard (NAAQS) for ozone and attainment for all other criteria pollutants. The facility is an existing major source under Prevention of Significant Deterioration (PSD) permitting requirements (promulgated in 326 IAC 2-2), because the permit limited potential to emit (PTE) of at least one attainment pollutant is at a level greater than its PSD major source threshold. The facility is similarly an existing major stationary source under the Emission Offset requirements (promulgated in 326 IAC 2-3), since emissions of VOC and NOx exceed the applicable 100 tpy threshold.

Representatives from MGPI held a pre-application meeting with Ms. Jenny Acker and Mr. Matthew Stuckey of IDEM on December 11, 2014 to discuss the project proposed in this application, to review preliminary drafts of the technical content comprising Appendix C and D, and to discuss MGPI's Best Available Control Technology (BACT) analysis. This application has been prepared to incorporate guidance received during the pre-application meeting.

1.1 Source Modification and Permit Modification Request

MGPI is submitting this application for a Part 70 combined source modification and permit modification for the proposed construction of a new distiller's dried grain (DDG) dryer. The proposed project will include installation of one new direct-fired DDG dryer, which will be equipped with cyclone and regenerative thermal oxidizer (RTO) controls. The installation of the new dryer will not affect the facility's production capacity; existing equipment will continue to dewater and convey stillage from the facility's distillation operations to the proposed dryer for drying, and the proposed dryer will not cause an increase in the facility's drying capacity or otherwise debottleneck facility operations. Downstream of the proposed dryer, the existing cooler and DDG transport system (portion of EU-32) will continue to operate at current capacities, and once DDG is produced in the dryer, it will be cooled, transported, stored, and loaded for off-site shipment using existing equipment.

MGPI intends that the proposed direct-fired dryer will be the primary means of producing DDG. However, to provide maximum operational flexibility, MGPI requests that the existing steam tube dryer operation (portion of EU-32) remain available to operate in the event the direct-fired dryer experiences downtime for maintenance. Additional details on the project are provided in Section 3.1.

The potential to emit (PTE) for the proposed project before controls, after controls, and after issuance of the requested permit is presented in Table 1. Since the proposed modification will be subject to 326 IAC 8-1-6 (new facilities; general reduction requirements), MGPI understands that this source modification is of a type addressed under 326 IAC 2-7-10.5(g) that IDEM will process according to the provisions of 326 IAC 2-7-10.5(h). MPGI is requesting that the preconstruction approval and operating permit revision for this project be combined, therefore this application includes the information as required under 326 IAC 2-7-10.5(d)(2).

2 Facility and Source Description

The MGPI facility is engaged in production of distilled spirits. This application focuses solely on the DDG dryer operations that are the subject of the proposed modification. A site layout of the MGPI facility is included in Figure 2 (as referenced in Form GSD-02 in Appendix A), and a process flow diagram for the proposed new dryer operations is included in Figure 3 (as referenced in Form GSD-03 in Appendix A).

Currently, still bottoms are conveyed from the distillation stills (EU-20, 25 – 29), through initial dewatering, and then to the DDG dryers (collectively EU-32). The existing dryers are each steam tube rotary units, with the steam supplied by the existing facility boilers (EU-96 and EU-97). After drying, the DDG is sent through a cooler (included within EU-32) prior to storage and loading for off-site shipment. The rotary dryers are each equipped with scrubbers for particulate emission control, and the cooler is equipped with a cyclone for particulate control.

2.1 Proposed Project Modification

MGPI is proposing to install one new direct-fired DDG dryer (proposed EU-39). Three new conveyors will feed wet distiller's grain to the proposed new dryer, where it will enter the dryer along with syrup from existing stillage processing and recycled product from the dryer itself. The unit will be equipped with a 45 MMBtu/hr natural gas-fired burner to accomplish the required drying.

Once dried, the DDG will be sent via enclosed conveyors to the existing DDG cooling and transport system (portion of existing EU-32). Existing equipment will be used to feed the DDG to a hammer mill (controlled by an existing cyclone) for milling, then on to a rotating drum cooler (which is a passive system that is not supplied with a source of forced air ventilation), and then to the existing DDG silos and surge hoppers (existing EU-34) for storage. From storage, the DDG will be transported and loaded onto either railcars or trucks for shipment off-site at existing load out stations (EU-35, EU-36, EU-37, and EU-38).

The production capacity of the new dryer will be equivalent to the capacity of the existing dryers; MGPI is not seeking an increase above currently permitted capacity with this application. Furthermore, upstream and downstream process operations will not be modified as part of this project. The stillage processing and conveying upstream of the dryer, as well as the DDG cooling/transport system and DDG storage/loading operations downstream of the dyer, will remain unchanged.

The exhaust from the new dryer will be routed through four cyclones to control PM emissions, then on to a new RTO for control of VOC, CO and HAP emissions. A portion of the exhaust stream will be recirculated as tempering air back to the dryer burner. The RTO will exhaust to a new stack where the dryer emissions will be vented to atmosphere.

During periods when the direct-fired dryer must be taken out of service for maintenance, MGPI will use the existing steam tube dryers so that facility operations are not interrupted. MGPI will not operate the new and existing dryers concurrently. The existing dryers will become stand-by units to cover operations when the new dryer is off-line and will not be modified as part of this project.

3 Emission Estimates

A summary of MGPI's site-wide potential to emit (PTE) is provided in Table 1 of this application, including emissions of criteria pollutants (NO_X, CO, SO_2, VOC, Total PM, PM_{10}, and $PM_{2.5}$), total emissions of hazardous air pollutants (HAPs), and emissions of greenhouse gases (GHGs). Table 1 includes potential emissions before controls, potential emissions after controls, and requested potential emissions after permit issuance. Detailed emission estimates for the emission sources included in this project are found in Tables C-1 through C-7 of Appendix C. Emission estimates for other sources are not provided; the emission rates shown for these sources in Table 1 are consistent with those documented in the Technical Support Document (TSD) that IDEM issued with permit renewal number T029-32119-00005 dated June 20, 2014.

3.1 DDG Dryer Emission Estimates

Emissions of criteria pollutants from the proposed DDG Dryer, provided in Table C-1, are calculated using controlled emission factors and associated control efficiencies as provided by the equipment vendor (ICM, Inc.). The factors account for total dryer emissions, comprised both of contributions from DDG drying and from the natural gas combustion that occurs in the burner for the direct-fired dryer and the RTO burner. Factors expressed on a heat input basis (lb emitted per MMBtu fired) are multiplied by the dryer's design maximum firing rate (dryer and RTO burners) to obtain a mass emission rate. Factors expressed on a throughput basis (lb emitted per ton of DDG produced) are multiplied by the maximum dryer throughput to obtain a mass emission rate. Annual emissions assume that the dryer operates as maximum capacity for the entirety of the year. Emissions of HAPs from the proposed DDG dryer, provided in Table C-2, are similarly calculated using controlled emission factors and associated control efficiencies provided by the equipment vendor. As seen in Table C-2, emissions of individual HAPs acetaldehyde, formaldehyde, acrolein, and methanol are calculated by multiplying the respective emission factor (lb emitted per ton of DDG produced) by the maximum dryer throughput. Total HAP emissions also include HAPs emitted solely by natural gas combustion, using the emission factors from AP-42 Tables 1.4-2 through 1.4-4.

Greenhouse Gas (GHG) emissions from the proposed DDG dryer are provided in Table C-3. Estimated GHG emission rates are calculated using the design firing rates of the dryer and RTO burners and emission factors taken from Tables C-1 and C-2 of 40 CFR Part 98. CO_{2e} emissions are calculated by applying the global warming potential (GWP) of each GHG to its mass emissions as prescribed by the United States Environmental Protection Agency (USEPA) in the Federal Register dated November 29, 2013 (78 FR71950).

3.2 DDG Cooler and Transport System Emission Estimates

Emission estimates for the DDG cooler and transport system located downstream of the direct-fired dryer are provided in Table C-4 and C-5. While existing equipment will continue to be used, emissions from these sources have not historically been estimated separately and were instead included as part of the steam tube dryer aggregate emissions from EU-32. Because the direct-fired dryer emissions are now being estimated independently, estimates for cooler and transport emissions are being provided at this time.

Uncontrolled and controlled emissions of PM, PM_{10} and $PM_{2.5}$ are included in Table C-4. Estimates use emission factors presented in AP-42 Table 9.9.1-1 (Grain Elevators and Processes). The grain conveying factors assume no control, so controlled and uncontrolled emissions are equivalent. Emissions from hammer milling are calculated using the AP-42 Table 9.9.1-1 controlled emission factor for PM, the suggested pre-control particle size distribution from AP-42, Appendix B.2, Table B.2.2 for Category 7 (Grain Processing), and the suggested particle size-specific control efficiencies for a high efficiency centrifugal collector from AP-42, Appendix B.2, Table B.2.3. Uncontrolled and controlled PM, PM10, and PM2.5 emission factors were calculated as presented in Table C-4.

The existing DDG cooler is not equipped with forced air ventilation; rather the DDG only experiences radiative cooling as it is conveyed through the unit. Therefore the AP-42 conveying factors are used to quantify fugitive particulate that may be emitted from the process.

VOC and HAP emission estimates from the DDG transport and cooling operations are provided in Table C-5. VOC emissions are calculated using emission factors taken from a similar operation permitted in Indiana (POET Biorefining – North Manchester, Permit #T169-31191-00068). HAP emissions are calculated as a percentage of total VOC emissions, by assuming that the individual HAPs emitted from cooling/transport operations are in the same proportion as those emitted from drying operations.

3.3 Wet Cake Emission Estimates

Emissions of VOCs and HAPs from wet cake operations have been presented in Table C-6, accounting for emissions that can result during dryer shutdown and startup at times when the dryer throughput is diverted to a wet pad (see Figure 3) to ensure that the wet feed is not sent to dry storage. Uncontrolled emission factors for VOCs and HAPs from wet cake operations have been taken from a similar operation permitted in Indiana (POET Biorefining – Alexandria, Permit # T095-30443-00127). While hourly dryer feed is assumed to be at its maximum, the annual feed assumes that wet cake production is limited to 500 hr/year.

3.4 Steam Tube Dryer Emission Estimates

Because the existing steam tube dryers may continue to be used as a backup unit to the proposed direct-fired dryer, estimates of emissions from the existing equipment are provided in Table C-7. Emissions are estimated consistent with the IDEM TSD that IDEM issued with permit renewal number T029-32119-00005 dated June 20, 2014.

4 Regulatory Analysis

This section of the application summarizes the applicability and non-applicability of state and federal regulations to the dryer project.

4.1 Federal Regulations

4.1.1 New Source Performance Standards

The proposed new DDG dryer will not be subject to requirements of 40 CFR 60 standards.

4.1.2 National Emission Standards for Hazardous Air Pollutants

The proposed DDG dryer will not be subject to requirements of 40 CFR 63 standards. Since the unit is direct-fired and is not used to generated steam, it does not meet the definition of either "boiler" or "process heater"; therefore the requirements of 40 CFR 63 Subpart DDDDD (National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters) do not apply.

Since no Part 63 Maximum Achievable Control Technology (MACT) standards apply to the proposed project, the "case-by-case" MACT provisions under Section 112(g) of the Clean Air Act potentially apply to the proposed project. However, as shown in this application, the potential dryer HAP emissions after control by the RTO will be well below the applicable major source thresholds (10 tpy of any individual HAP or 25 tpy of total HAP). Accordingly, Section 112(g) case-by-case MACT requirements do not apply because the project itself does not constitute construction of a new major HAP source.

4.1.3 Compliance Assurance Monitoring

The proposed direct-fired dryer is potentially subject to Compliance Assurance Monitoring (CAM) requirements under 40 CFR 64. The unit will use a control device to achieve compliance with the requirement for BACT (under 326 IAC 8-1-6, as described in Section 4.2.6 and Section 5), and as shown in Table 1, has potential pre-control device emissions for VOC that are greater than the 100 tpy Part 70 major source threshold. MGPI understands that as part of the Source Modification and Part 70 Permit Modification, IDEM will require the following monitoring of the RTO:

- Continuous monitoring of RTO combustion chamber operating temperature to assure that the VOC destruction efficiency is maintained at or above the level measured in the most recent stack test. This parameter monitoring system will include acquisition of temperature data no less than once per fifteen minutes. The output of the monitoring system will be recorded as a 3-hour block average. MGPI must operate the RTO at or above the 3-hour block average temperature as observed during the unit's initial stack test.

- Monitoring of the appropriate RTO inlet duct static pressure or RTO fan amperage to assure sufficient flow is maintained to capture all of the VOC / HAP emission from the DDG dryer. This parameter monitoring system will include acquisition of static pressure or fan amp data at least once per day when the RTO is in operation. The daily duct pressure or fan amperage must be maintained within the normal range as established during the unit's initial stack test.

With these monitoring requirements in place and with enforceable limits on the emissions from the RTO stack, MGPI understands that CAM requirements will be satisfied.

4.2 Indiana State Regulations

4.2.1 Prevention of Significant Deterioration (326 IAC 2-2)

The MGPI facility is located in Dearborn County Lawrenceburg Township, which is designated as attainment or unclassifiable for the NAAQS for nitrogen dioxide, CO, lead, PM, PM_{10}, $PM_{2.5}$, and sulfur dioxide. A PSD permit is required for a project that constitutes a new major source or major modification to an existing major source. Under PSD rules, a major source is defined as any one of the following:

1. Any stationary source that is located or proposed to be located in an attainment or unclassifiable area as designated in 326 IAC 1-4 and that emits or has the potential to emit 100 tons per year or more of any regulated NSR pollutant (326 IAC 2-2(ff)(1));

2. Any stationary source with the potential to emit 250 tons per year or more of a regulated NSR pollutant (326 IAC 2-2(ff)(2)); or

3. For any stationary source that does not meet the definition of 1) or 2), any physical change that would constitute a major stationary source by itself (326 IAC 2-2(ff)(5)).

Distilled spirits production plants are not included on the list of 28 source categories under 326 IAC 2-2(ff)(1). However, the MGPI facility does have the potential to emit over 250 tpy of PM, PM_{10}, $PM_{2.5}$, and NO_x and therefore is an existing major source under the PSD rules.

A major modification is defined under 326 IAC 2-2(dd) as follows:

> …any physical change in, or change in the method of operation of, a major stationary source that would result in a significant emissions increase and a significant net emissions increase of a regulated NSR pollutant from the major stationary source.

As an existing PSD major source, MGPI is required to assess whether the proposed dryer project has the potential to increase emissions of any regulated PSD pollutant. If the project emissions increase or the project net emissions increase for each PSD pollutant is less than its significant emission rate, the project would not be subject to PSD review. MGPI has assessed the dryer project emission increases by comparing the projected actual emissions following the dryer installation to the past actual emissions (those occurring during the highest 24-month baseline period of January 2012 through December 2013 for all pollutants).

The results of the PSD applicability analysis, summarized in Table 2 and provided in Appendix D, show that the project emissions increases will be below the applicable PSD significance levels. Therefore, the project does not represent a physical modification that results in a significant emissions increase, and does not trigger PSD permitting requirements for any pollutant.

4.2.2 Emission Offset (326 IAC 2-3)

The MGPI facility is located in Dearborn County Lawrenceburg Township, which is designated as nonattainment for the NAAQS for ozone (2008 8-hour standard). The Emission Offset/ Nonattainment New Source Review (NNSR) rules potentially apply to the proposed dryer project. The MGPI facility has the potential to emit over 100 tpy of VOC and NO_x and therefore is an existing major source under the Emission Offset rules. Therefore, MGPI is required to evaluate VOC and NOx emissions to determine whether the proposed dryer project has the potential for an increase in emissions. If the project emissions increases or project net emissions increases for VOC and NOx are below their respective significant emission rates, the project would not be subject to Emission Offset provisions.

The results of the NNSR applicability analysis, summarized in Table 2 and provided in Appendix D, show that the project emissions increases for VOC and NOx will be below the applicable significance levels. Therefore, the project does not represent a physical modification that results in a significant emissions increase, and does not trigger Emission Offset requirements.

4.2.3 Prevention of Significant Deterioration for Greenhouse Gases (40 CFR 52)

The Supreme Court ruled on June 23, 2014 (*Utility Air Regulatory Group v Environmental Protection Agency*) that USEPA could not change the major source thresholds legislated in the Clean Air Act as it had done in the Federal Tailoring Rule (75 FR 31514, June 3, 2010). The ruling further stated that USEPA could not treat greenhouse gases as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD permit, but that USEPA could continue to require that PSD permits, otherwise required based on emissions of conventional pollutants, contain limitations on GHG emissions based on the application of BACT.

In a July 24, 2014 memorandum, USEPA expressed the agency's intent to act consistent with its understanding of the Supreme Court's decision. USEPA will no longer apply or enforce regulatory provisions that require a stationary source to obtain a PSD permit if greenhouse gases are the only pollutant that (a) the source emits or has the potential to emit above the major source thresholds, or (b) for which there is a significant emissions increase and a significant net emissions increase from a modification. Nor will USEPA continue to apply regulations that would require that states include in their State Implementation Plans a requirement for such sources to obtain PSD permits.

The emission increases of conventional pollutants resulting from the proposed project at MGPI do not trigger PSD permitting requirements for conventional pollutants. Therefore, consistent with the Supreme Court decision, the project does not trigger PSD permitting requirements (application of BACT) for GHG. Moreover, the increase in GHG emissions associated with the project are not high enough to have triggered GHG BACT in the absence of the court decision.

4.2.4 Pollutant-Specific General Limitations

The following pollutant-specific general emission limitations apply to the proposed dryer project at MGPI:

- Particulate Matter Emission Limitations for Manufacturing Processes (326 IAC 6-3-2)

The particulate emissions from the proposed dryer, as shown in Table C-1, will comply with the applicable process weight rate-based limit calculated according to 326 IAC 6-3-2(e). The proposed project will similarly not affect the on-going compliance of the DDG cooler and transport system with the applicable process weight rate-based limit. These limits are shown below:

Emission Unit	Unit Description	Process Weight Rate (ton/hr)	Allowable Particulate Emission Rate (lb/hr)
EU-39 (Proposed)	Direct-fired DDG Dryer	17.75	28.2
EU-32	DDG Cooler and Transport System	7.0	15.1

- Preventive Maintenance Plan (326 IAC 2-7-5(12)

As required under 326 IAC 2-7-5(12), MGPI will maintain on-site the preventive maintenance plans required under 326 IAC 2-7-4(c)(8), implement the preventive maintenance plans, and forward a plan to IDEM upon request. The plans, addressing the proposed RTO and the cyclone operating within the cooler/transport system, will include the following content required under 326 IAC 1-6-3(a):

- Identification of the individual(s) responsible for inspecting, maintaining, and repairing the emission control device
- A description of the items or conditions that will be inspected and the inspection schedule for said items or conditions
- Identification and quantification of the replacement parts which will be maintained in inventory for quick replacement.

The VOC emission reduction requirements of 326 IAC 8-5-6 do not apply to the proposed project since MGPI is not a fuel grade ethanol production facility.

4.2.5 Opacity Limitations (326 IAC 5-1)

As specified under 326 IAC 5-1-1(c)(2), visible emissions from the proposed DDG dryer stack will be required to comply with the opacity requirement of 326 IAC 5-1-2(2), which limits opacity to 30% opacity in any one six-minute averaging period as determined in 326 IAC 5-1-4. Opacity shall not exceed 60% for more than a cumulative total of 15 minutes (60 readings as measured according to 40 CFR 60, Appendix A, Method 9) in a six-hour period.

4.2.6 New Facilities General Reduction Requirements (326 IAC 8-1-6)

The proposed dryer is subject to the general VOC reduction requirements under 326 IAC 8-1-6, which provide that a new facility not otherwise regulated by a standard under 326 IAC 8, 326

IAC 20-48, or 326 IAC 20-56 must reduce VOC emissions using Best Available Control Technology (BACT). Section 5 of this application has been prepared in response to this requirement. Completed IDEM BACT Analysis permit application forms are included in Appendix B.

5 BACT Analysis

The IDEM regulations at 326 IAC 8-1-6 impose general VOC reduction requirements for new facilities (constructed after January 1, 1980) having a potential to emit greater than 25 tpy VOC. Specifically, such facilities must use BACT to reduce VOC emissions. As discussed previously, the potential VOC emissions from the proposed direct fired dryer prior to emission controls is greater than 25 tpy, and therefore MGPI is required to perform a top-down BACT analysis to identify the level of control required.

Before discussing the proposed VOC BACT that MGPI has selected for the direct fired dryer, a general overview of the top-down BACT approach is provided in Section 5.1. A technical review of the potentially applicable controls for the dryer VOC emissions is presented in Section 5.2, with technically infeasible options eliminated in Section 5.3. The remaining technologies are ranked and evaluated in Section 5.4 and the selection of BACT is presented in Section 5.5.

5.1 BACT Defined

BACT is defined under 326 IAC 1-2-6 as "an emission limitation (including a visible emission standard) or equipment standard based on the maximum degree of reduction of each pollutant subject to regulation… which the commissioner, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for such facility or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant." Four key aspects of the definition for conducting a BACT analysis are the following:

- BACT is an "emission limitation" based on a control technology and not the control technology itself; if technological or economic limitations on the application of measurement methodology to a particular emissions unit would not be feasible, a design, equipment, work practice, operation standard, or combination thereof may be prescribed.
- BACT is based on the "maximum degree of emissions limitation achievable...". Economic, environmental, and energy impacts are taken in to account, but equal emphasis is also placed on the words "maximum" and "achievable."
- BACT includes and, in fact, focuses on "production processes..." along with add-on controls.
- BACT was intended to be a case-by-case evaluation, implying individual case evaluations and decisions, not rigid, pre-set guidelines.

5.1.1 "Top-Down" Method for Determining BACT

The "top-down" method of determining BACT consists of identifying the methods that can be applied or have been applied for control of a particular pollutant. The methods are then ranked from most effective to least, with the most effective control technology as the "top" option. Starting with the top control option, each method is reviewed for technical feasibility as well as for energy, environmental, and economic impacts. If the top option is eliminated after a review of these criteria, the next most effective control option is reviewed. This process continues until BACT is determined. The following steps, based on IDEM's BACT Analysis Application guidance and consistent with IDEM's BACT permit application forms, further outline the steps in the top-down BACT process:

Step 1 – Identify Control Technologies

The first step in the top-down BACT approach is to define the spectrum of process and/or add-on control alternatives potentially applicable to the proposed emissions unit. The following categories of technologies are addressed in identifying candidate control alternatives:

- Demonstrated add-on control technologies applied to the same emissions unit at other similar source types;
- Add-on controls not demonstrated for the source category in question but transferred from other source categories with similar emission stream characteristics;
- Process controls such as combustion or alternate production processes;
- Add-on control devices serving multiple emissions units in parallel; and
- Equipment or work practices, especially for fugitive or area emission sources where add-on controls are not feasible.

A review of the EPA's RACT/BACT/LAER Clearinghouse (RBLC) database is usually the first step in this process.

Step 2 – Eliminate Technically Infeasible Options

The second step in the top-down BACT approach is to evaluate the technical feasibility of the alternatives identified in Step 1 and to reject those which can be demonstrated as infeasible based on engineering evaluation or on chemical or physical principles. The following criteria are considered in determining technical feasibility: previous commercial scale demonstrations, precedents based on previous permits, and technology transfer from similar sources.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

Step 3 is an assessment and documentation of the emission limit achievable with each technically feasible alternative considering the specific operating constraints of the emissions units undergoing review. After determining what control efficiency is achievable with each alternative, the alternatives are rank-ordered into a control hierarchy from most to least stringent.

Step 4 – Evaluate Most Effective Controls and Document Results

Step 4 is to evaluate the cost/economic, environmental, and energy impacts of the top or most stringent technique. To reject the top alternative, it must be demonstrated that this control alternative is infeasible based on the results of the impacts analysis. If a control technology is determined to be technically infeasible or infeasible based on cost effectiveness, or to cause adverse energy or environmental impacts (including toxic pollutant impacts), the control technology is rejected as BACT and the impacts analysis is performed on the next most stringent control alternative.

Step 5 – Select BACT

The proposed BACT is the option with the highest control effectiveness that was not eliminated in step 4 due to adverse economic, environmental, and/or energy impacts.

5.2 Control Technology Evaluation

Based on a review of the RBLC database, a review of permits that IDEM has recently issued, and a general literature search, several add-on control alternatives are potentially applicable to control VOC emissions from the proposed direct-fired dryer. Any control technology chosen must be able to effectively reduce VOC emissions in the dryer exhaust stream given the following characteristics:

- Maximum flow rate of approximately 30,000 acfm;
- High dryer exhaust temperature (approximately 215°F);
- High moisture content resulting from water driven off from the DDG within the dryer;

The RBLC search did not locate entries for distilled spirits production, so the search instead focused on recent applications of BACT at DDG dryers located within dry mill fuel ethanol facilities. Though facilities engaged in fuel ethanol production are typically on a much larger scale than MGPI's facility, the process of producing DDG from spent stillage at MGPI shares a common principal of operation with the similar process at fuel ethanol plants. The technologies applied for control of VOC emissions from direct-fired DDG dryer exhaust at fuel ethanol plants are therefore considered to be potentially applicable for MGPI's proposed direct-fired dryer.

A description of candidate technologies is provided in the following sections.

5.2.1 Carbon Adsorption

Carbon adsorption is a mature technology that has been used for the last 50 years to recover solvents from solvent-laden air streams. Activated carbon, which has a high surface area-to-volume ratio and a preferential affinity for organics, can serve as a very effective adsorbent of low-solubility, high molecular weight VOM. Non-carbon adsorbents can also be used. A desorption process recovers the organic compounds from the adsorbent, which can then be reused. While the RBLC did not indicate any applications of carbon adsorption for control of direct-fired dryer VOC emissions, it is an established VOC control technology. Therefore, carbon adsorption is considered to be a potentially applicable technology for control of VOC emissions from MGPI's proposed direct-fired dryer.

5.2.2 Wet Scrubbing

Wet scrubbers absorb VOC such as that emitted by the proposed direct-fired dryer (ethanol with lesser amounts of acetaldehyde, formaldehyde, acrolein, and methanol) into an absorbing liquid like water. Effective absorption requires a large gas to liquid surface area to optimize the mass transfer of the pollutant from the gas to the liquid phase. Gas/liquid contact is enhanced through the use of hydraulic sprays, trays, or packing in the scrubbing tower to create a large surface area while minimizing the liquid flow rate. Wet scrubbing applications for control of VOC emissions from direct-fired dryers were not identified in the RBLC. Application of scrubber technology has been used to control VOC emissions from other operations within ethanol manufacture in general (typically to control VOC emitted during fermentation operations). IDEM's regulations at 326 IAC 8-5-6(c)(2) provide for the use of web scrubbing as a means to comply with the requirement for dry mill fuel grade ethanol production plants that meet the applicability provisions under 326 IAC 8-5-6(a) to control VOC emissions by no less than 98%. Wet scrubbing is therefore considered to be potentially applicable for MGPI's proposed direct-fired dryer.

5.2.3 Thermal or Catalytic Oxidization

In a thermal oxidizer, the VOCs in a gas stream are subjected to high temperatures in the presence of oxygen. The VOC is oxidized to carbon dioxide and water, with the generation of combustion byproducts.

An RTO is a more energy efficient technology than a thermal oxidizer. Within an RTO, the vent gas stream passes through one of two chambers filled with ceramic packing where it is pre-heated to temperatures approaching the desired combustion chamber set point before passing into a central combustion chamber. Some of the VOC is oxidized in the pre-heat chamber, while the remainder is oxidized in the central combustion chamber. Following combustion, the vent gas is passed through the second ceramic packing chamber and transfers its heat to the ceramic material. The RTO then cycles and the lead and lag chambers are switched, so that the second chamber provides pre-heating to the vent gas stream and the first is heated by the gas downstream of the combustion chamber. The cycling occurs so that the RTO system approaches steady-state conditions and the energy efficiency of the unit is optimized.

IDEM's regulations at 326 IAC 8-5-6(c)(2) provide for the use of thermal oxidation as a means to comply with the requirement for dry mill fuel grade ethanol production plants that meet the applicability provisions under 326 IAC 8-5-6(a) to control VOC emissions by no less than 98%. Thermal oxidation is the overwhelmingly predominant control device used at fuel ethanol plants to control direct-fired dryer VOC emissions. In the completed application form BACT-01 (Summary of Existing BACT Determinations) in Appendix D, the five BACT Determinations that are listed from an RBLC search each specify the use of a thermal oxidizer. Of these, 3 require 98% control, one requires 95% control, and one requires that a lb/MMBtu emission limit be met. Similarly, a survey of recent air permits for fuel ethanol plants in Indiana shows that thermal oxidation is the dominant control technology in use. A sample of recent permits for plants equipped with thermal oxidization control of dryer VOC emissions is included in Table 3, including a listing of the required level of VOC control.

5.2.4 Condensation

In condensation, the VOC in the exhaust stream undergoes a change from gaseous phase to liquid phase driven by a decrease in temperature, increase in pressure, or a combination of both. Condensers are most effective on VOCs that have relatively low vapor pressure (i.e., will condense without the need to a high level of cooling) and are present near their saturation level in the vent stream. While the RBLC did not indicate any applications of condensation for control of direct-fired dryer VOC emissions, it is an established VOC control technology. Therefore, condensation is considered to be a potentially applicable technology for control of VOC emissions from MGPI's proposed direct-fired dryer.

5.2.5 Flaring

Flaring is a common VOC control device in which a VOC-containing vent stream is vented to an open flame where it is combusted. Auxiliary fuel is commonly required to ensure an adequate heat content of the vent stream, and steam or air is added to promote mixing within the vent stream to increase the completeness of combustion (and therefore increase the level of VOC destruction). Flare performance depends on the flame temperature, the residence time of the vent gas in the combustion zone, the degree of mixing within the gas stream, and the amount of oxygen available to prevent free radical formation. Similar to the combustion processes described in Section 5.2.3, combustion byproducts will be formed when an emission vent stream is treated in a flare.

Flaring applications for control of VOC emissions from direct-fired dryers were not identified in the RBLC, however the principle of flare operation (i.e., control of VOC emissions through thermal destruction) is similar to thermal oxidation as discussed in Section 5.2.3. IDEM's regulations at 326 IAC 8-5-6(c)(2) provide for the use of an enclosed flare as a means to comply with the requirement for dry mill fuel grade ethanol production plants that meet the applicability provisions under 326 IAC 8-5-6(a) to control VOC emissions by no less than 98%. Flaring is therefore considered to be potentially applicable for MGPI's proposed direct-fired dryer.

5.3 Elimination of Technically Infeasible Options

The following technologies are considered to be technically infeasible, based on engineering evaluation or on chemical or physical principles, for application at MGPI. These technologies are therefore rejected as BACT for the control of VOC emissions from the proposed direct-fired dryer.

5.3.1 Carbon Adsorption

Carbon adsorption has not been demonstrated on an industrial scale for control of VOC from DDG drying operations. Due to the relatively low VOC concentration in the dryer exhaust stream and its relatively high moisture content, the potential would exist for condensation of water which could block effective carbon surface area. Dehumidification of the stream would be necessary, which would involve cooling the hot dryer exhaust vent. This additional process step is not considered to be technically feasible. Even if dehumidification were achieved, the potential effectiveness of activated carbon controls is severely limited due to the low concentration of VOC in the exhaust stream for control. Therefore, carbon adsorption controls are considered to be technically infeasible and are rejected as BACT for control of VOC from the proposed direct fired dryer.

5.3.2 Condensation

The DDG dryer exhaust characteristics make the control of VOC emissions with a refrigerated vent condenser inappropriate. An inordinately large amount of energy would be required to cool the relatively large volume exhaust air stream from its exit temperature of approximately 215°F to a temperature where ethanol (and the other VOC constituents in the vent stream) would condense in appreciable amounts, especially given their relatively low vapor concentrations that translate to very low dew points. Therefore, condenser controls are considered to be technically infeasible and are rejected as BACT for control of VOC from the proposed direct fired dryer.

5.4 Rank and Evaluate Remaining Technologies

The remaining technologies that are considered to be technically feasible for control of dryer VOC emissions are listed below, according to rank in order from most stringent to least stringent control based on information either in the RBLC, recent air permits, or as represented in studies.

Control Technology	Level of VOC Control
Thermal Oxidation	98% Reduction or 10 ppm_v outlet concentration
Wet Scrubbing	98% Reduction or 10 ppm_v outlet concentration
Flaring	98% Reduction or 10 ppm_v outlet concentration

Since each technology is capable of achieving an equivalent level of control (98% of VOC emissions), either thermal oxidation, wet scrubbing, or flaring could be considered the top-ranked control. According to USEPA Guidance (New Source Review Workshop Manual, Draft October 1990), "…an applicant proposing the top control alternative need not provide cost and other detailed information in regard to other control options. In such cases the applicant should document that the control option chosen is, indeed, the top, and review for collateral environmental impacts."

Of the three alternatives, thermal oxidation is by far the most commonly used control in practice for control of VOC emissions from DDG drying operations, as listed in the completed BACT-01 form and in Table 3. Other considerations with respect to environmental and energy impacts are listed below:

- Thermal oxidation and flaring, unlike wet scrubbing, do not result in the generation of another process stream (scrubber water) requiring subsequent treatment or disposal;

- Thermal oxidation provides similar control to flaring, but operates more efficiently, particularly in the case of an RTO where a substantial portion of the waste heat is recovered and used to pre-heat the incoming vent stream for treatment (typical thermal efficiencies in excess of 90%).

- Additional energy requirements (i.e., natural gas consumption) would be necessary to operate an RTO. In the case of MGPI, however, this impact is countered by the fact that under normal facility operation as proposed, the direct-fired dryer would operate in lieu of the facility's existing steam tube dryers. The increased natural gas use at the proposed dryer/controls would be balanced by a decrease in steam demand at the steam tube dryers. Natural gas consumption by the facility's existing boilers would therefore decrease. MGPI estimates that, under current operations with steam tube drying, approximately 1,120 Btu steam energy are required per pound of water evaporated.

When the proposed direct-fired dryer and controls are in operation, this rate is expected to remain essentially the same for a given evaporative load.

- Thermal oxidation provides effective reduction of HAP emissions contained in the DDG dryer exhaust, representing the elimination of an adverse environmental impact that would result from its implementation.

Based on the reasons listed above, MGPI believes thermal oxidation to be the most advantageous of the top ranked technologies with respect to environmental and energy impacts.

5.5 Select BACT

MGPI proposes the following operational and emission limits as BACT for control of VOC emissions from the proposed direct-fired dryer:

- The VOC emissions from the proposed direct-fired DDG dryer shall be controlled by an RTO
- The RTO shall operate with an overall control efficiency, which includes capture and destruction efficiencies, of not less than 98% or resulting in a VOC outlet concentration of not more than 10 ppm_v.

MGPI has included a completed CE-06 application form in Appendix A describing the RTO proposed for installation. Included on this form are the associated testing, monitoring, and recordkeeping procedures that MGPI is proposing for the operation of the unit.

The completed BACT application forms in Appendix B support the analysis provided above. A completed BACT-01b form is not included; a detailed economic evaluation is not required as part of this application because MGPI is proposing the top control alternative.

Tables

Figures

Appendix A

IDEM Permit Application Forms

Appendix B

IDEM BACT Analysis Application Forms

Appendix C
Emission Estimates

Appendix D

PSD/NNSR Applicability